

REMARKS

The Examiner's careful review and examination of the subject application are noted and appreciated. The present amendments present the rejected claims in better form for condition on appeal.

The present invention relates to a hydrogen storage material consisting essentially of a hydrogen storage alloy having the formula $Ti_U Zr_V Mn_W Cr_X V_Y A_z$, wherein A is one or more elements selected from the group consisting of Fe, Ni, and Al; $0.75 \leq U \leq 0.95$, $0.05 \leq V \leq 0.25$, $0.6 \leq W \leq 1.31$, $0.42 \leq X \leq 1.1$, $0.20 \leq Y \leq 0.45$, $0.12 \leq Z \leq 0.36$, $U + V = 1.0$, and $1.95 \leq (W + X + Y + Z)/(U + V) \leq 2.05$.

The current amendments to independent claim 1 have significantly narrowed the previously presented claim 1 to avoid the cited references and have also placed the formula in better form for comparison to Lee et al. Vanadium has been separated out of the original "A" variable and the amounts of Ti and Mn are now represented independent from the other elements. All of the amended ranges fall within the ranges presented in independent claim 1 as presented in the previous amendment and have been amended with regard to the values listed in Table 1 as included in the specification as originally filed.

Currently amended claim 1 does not include any new matter, but is a significantly narrowed version of the previously presented claim 1 submitted in response to the Office Action of April 9, 2003. Not only were the ranges further limited by the current

amendment, an additional limitations were included which further limited the scope of the alloys presently claimed. The limitation $1.95 \leq (W + X + Y + Z)/(U + V) \leq 2.05$ significantly narrows the alloys covered by the previously presented Claim 1, while the limitation $U + V = 1$ was included to keep the presently claimed alloy ranges within the scope of the ranges claimed in the previously presented Claim 1.

The formula in currently amended Claim 1 includes all of the same elements from previously presented Claim 1 and the ranges associated with the elements as currently amended are the same as or narrower than the ranges as previously presented. As such the current amendment does not incorporate new matter into independent Claim 1 which would necessitate a new search. Listed below in Table 1 is a list of the element ranges of previously presented Claim 1 and currently amended Claim 1.

Table 1

Previously Presented Claim 1			Currently Amended Claim 1		
Elements	Minimum Atomic %	Maximum Atomic %	Elements	Minimum Atomic %	Maximum Atomic %
Ti	18.03%	36.84%	Ti	24.59%	32.20%
Zr	1.64%	12.28%	Zr	1.64%	8.47%
Mn	0.00%	62.46%	Mn	19.67%	44.41%
Cr	0.00%	38.60%	Cr	13.77%	37.29%
V, Fe, Ni, Al	10.49%	63.16%	V, Fe, Ni, Al	10.49%	27.46%

Applicants have carefully reviewed the above-identified Office Action and have significantly narrowed independent claim 1 to avoid the prior art currently cited. Applicants contend that, in view of the clarifying remarks set forth herein, all bases of objection and rejection have been overcome. Accordingly, Applicants respectfully request withdrawal of the pending rejections and allowance of the claims submitted.

SUPPORT FOR CLAIM AMENDMENTS

Support for amendment to the claims can be found in, for example, pages 7 and 8 of the specification as originally filed. As such, no new matter has been added.

CLAIM REJECTIONS UNDER 35 U.S.C. §112

The rejection to claims 9-16 and 18-22 under 35 U.S.C. §112 has been obviated by appropriate amendment and should be withdrawn. Claims 9-16 and 18-22 have been canceled from the presently pending application.

OBVIOUSNESS-TYPE DOUBLE PATENTING

The rejection of claims 1-8 based on the judicially created doctrine of obviousness-type double patenting over claims 1-13 of Ovshinsky et al. (U.S. Pat. No. 6,672,078) has been obviated and

should be withdrawn. A terminal disclaimer in compliance with 37 C.F.R. §1.321 is filed herewith.

The rejection of claims 23-30 based on the judicially created doctrine of obviousness-type double patenting over claims 1-13 of Ovshinsky et al. (U.S. Pat. No. 6,672,078) in view of Venkatesan et al. (U.S. Pat. No. 4,728,586 A) has been obviated and should be withdrawn. Claims 23-30 depend from independent claim 1, which is now believed to be allowable. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

CLAIM REJECTIONS UNDER 35 U.S.C. §102

For the reasons which follow hereinafter, the rejection of claims 1-4, 7, 8, and 23 under 35 U.S.C. §102 as being anticipated by Nakamura et al. (U.S. Pat. No. 5,581,690) has been obviated by appropriate amendment and should be withdrawn.

Nakamura et al. discloses a hydrogen storage alloy having a composition of $Ti_{1-x-z}\alpha_zY_xMn_{y-w}\beta_w$ (see col. 6, lines 44-49). In Tables 1-3 in col. 5 of Nakamura et al., several comparative examples are listed which do not contain Yttrium.

In contrast, the presently pending invention claims a hydrogen storage alloy consisting essentially of Ti, Zr, Mn, Cr, V, and A, wherein A is one or more of Fe, Ni, or Al. Nakamura et al. do not

disclose an alloy consisting essentially of Ti, Zr, Mn, Cr, V, and A, wherein A is one or more of Fe, Ni, or Al as presently claimed. In particular, the comparative examples disclosed by Nakamura, either include yttrium, or do not include both chromium and vanadium as presently claimed. As such, the presently pending invention is readily distinguishable and clearly patentable over the cited reference and the rejection should be withdrawn.

CLAIM REJECTION UNDER 35 U.S.C. §103

For the reasons which follow hereinafter, the rejection of claims 1-8, 10, 12, 15, 16, and 18-22 under 35 U.S.C. §103 as being unpatentable over Lee et al. has been obviated by appropriate amendment and should be withdrawn.

Lee et al. teaches hydrogen storage material employing Ti-Mn alloy system (Title). The Ti-Mn alloy system for hydrogen storage has a C14 crystal structure, and is represented as $Ti_uZr_vMn_wCr_xV_yX_z$, wherein X is at least one element selected from the group consisting of Fe, Al, and Ni; u, v, w, x, y, and z are mole numbers of each components; $0.7 < u < 1.0$; $0 < v < 0.3$; $1.0 \leq w \leq 1.3$; $0.1 \leq x \leq 0.4$; $0 < y < 0.3$; $0 \leq z \leq 0.2$; $0.7 < u + v < 1.0$; and, $1.4 \leq w + x + y + z \leq 2.0$ (see abstract, col. 2, line 57 through col. 3, line 2, and claim 1).

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula $Ti_uZr_vMn_wCr_xV_yA_z$, wherein A is one

or more elements selected from the group consisting of Fe, Ni, and Al; $0.75 \leq U \leq 0.95$, $0.05 \leq V \leq 0.25$, $0.6 \leq W \leq 1.31$, $0.42 \leq X \leq 1.1$, $0.20 \leq Y \leq 0.45$, $0.12 \leq Z \leq 0.36$, $U + V = 1.0$, and $1.95 \leq (W + X + Y + Z)/(U + V) \leq 2.05$. Lee et al. do not teach a hydrogen storage alloy as presently claimed. In particular, Lee et al. does not teach a hydrogen storage alloy whereby $0.42 \leq Cr \leq 1.1$, and $1.95 \leq (Mn + Cr + V + Fe + Ni + Al)/(Ti + Zr) \leq 2.05$. Shown below in Tables 2, 3, and 4, show comparisons of the chromium content between the alloys presently claimed in currently amended Claim 1 and the alloys disclosed by Lee et al.

Table 2

Lee et al. Reference		Current Application			
$(Mn + Cr + V + Fe + Ni + Al)/(Ti + Zr) = 1.95$					
Ti + Zr	Mn+Cr+V+Fe+Ni+Al	Maximum atomic % Cr	Ti + Zr	Mn+Cr+V+Fe+Ni+Al	Minimum atomic % Cr
0.9	1.755	15.07%	0.9	1.755	15.82%
0.91	1.7745	14.90%	0.91	1.7745	15.65%
0.92	1.794	14.74%	0.92	1.794	15.48%
0.93	1.8135	14.58%	0.93	1.8135	15.31%
0.94	1.833	14.42%	0.94	1.833	15.15%
0.95	1.8525	14.27%	0.95	1.8525	14.99%
0.96	1.872	14.12%	0.96	1.872	14.83%
0.97	1.8915	13.98%	0.97	1.8915	14.68%
0.98	1.911	13.84%	0.98	1.911	14.53%
0.99	1.9305	13.70%	0.99	1.9305	14.38%
1	1.95	13.56%	1	1.95	14.24%

Table 3

Lee et al. Reference			Current Application		
$(\text{Mn} + \text{Cr} + \text{V} + \text{Fe} + \text{Ni} + \text{Al}) / (\text{U} + \text{V}) = 2.00$					
Ti + Zr	Mn+Cr+V+ Fe+Ni+Al	Maximum atomic % Cr	Ti + Zr	Mn+Cr+V+ Fe+Ni+Al	Minimum atomic % Cr
0.9	1.8	14.81%	0.9	1.8	15.56%
0.91	1.82	14.65%	0.91	1.82	15.38%
0.92	1.84	14.49%	0.92	1.84	15.22%
0.93	1.86	14.34%	0.93	1.86	15.05%
0.94	1.88	14.18%	0.94	1.88	14.89%
0.95	1.9	14.04%	0.95	1.9	14.74%
0.96	1.92	13.89%	0.96	1.92	14.58%
0.97	1.94	13.75%	0.97	1.94	14.43%
0.98	1.96	13.61%	0.98	1.96	14.29%
0.99	1.98	13.47%	0.99	1.98	14.14%
1	2	13.33%	1	2	14.00%

Table 4

Lee et al. Reference			Current Application		
$(\text{Mn} + \text{Cr} + \text{V} + \text{Fe} + \text{Ni} + \text{Al}) / (\text{Ti} + \text{Zr}) = 2.05$					
Ti + Zr	Mn+Cr+V+ Fe+Ni+Al	Maximum atomic % Cr	Ti + Zr	Mn+Cr+V+ Fe+Ni+Al	Minimum atomic % Cr
0.9	1.845	14.57%	0.9	1.845	15.30%
0.91	1.8655	14.41%	0.91	1.8655	15.13%
0.92	1.886	14.31%	0.92	1.886	14.97%
0.93	1.9065	14.20%	0.93	1.9065	14.81%
0.94	1.927	14.10%	0.94	1.927	14.65%
0.95	1.9475	14.00%	0.95	1.9475	14.50%
0.96	1.968	13.90%	0.96	1.968	14.34%
0.97	1.9885	13.80%	0.97	1.9885	14.20%
0.98	2.009	13.70%	0.98	2.009	14.05%
0.99	2.0295	13.61%	0.99	2.0295	13.91%
1	2.05	13.51%	1	2.05	13.77%

As shown by tables 2, 3, and 4, the alloys taught by Lee et al. do not have the chromium content presently claimed in currently amended Claim 1 when taking into account the limitation $1.94 \leq W + X + Y + Z)/(U + V) \leq 2.05$. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

For the reasons which follow hereinafter, the rejection of claims 1-6 and 23 under 35 U.S.C. §103 as being unpatentable over Doi et al. has been obviated by appropriate amendment and should be withdrawn.

Doi et al. teaches hydrogen absorbing nickel based alloy and rechargeable alkaline battery (Title). The alloy taught by Doi et al. are nickel based alloys comprising 5-25 wt % Ti, 10-37 wt % Zr, 4-20 wt % Mn, 0.1-12 wt % V, 0.01-5 wt % Fe, 0.01-4.5 wt % Al, and balance Ni.

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula $Ti_U Zr_V Mn_W Cr_X V_Y A_Z$, wherein A is one or more elements selected from the group consisting of Fe, Ni, and Al; $0.75 \leq U \leq 1.05$, $0.05 \leq V \leq 0.35$, $0.6 \leq W \leq 1.31$, $0.42 \leq X \leq 1.1$, $0.15 \leq Y \leq 0.45$, $0.06 \leq Z \leq 0.36$, and $1.95 \leq (W + X + Y + Z)/(U + V) \leq 2.05$. Doi et al. does not teach a hydrogen storage alloy as presently claimed. In particular, Doi et al. teaches a nickel based alloy, whereby the alloy as presently claimed is not

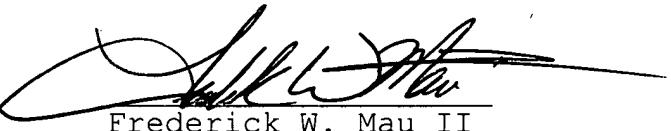
nickel based and contains only minimal amounts of nickel. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

For the reasons which follow hereinafter, the rejection of claims 24-30 under 35 U.S.C. §103 as being unpatentable over Nakamura et al. (U.S. Pat. No. 5,851,690) in view of Venkatesan et al. (U.S. Pat. No. 4,728,586 A) has been obviated by appropriate amendment and should be withdrawn. Claims 24-30 depend, directly or indirectly, from independent claim 1, which is now believed to be allowable. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

Accordingly, Applicant submits that the present amendment places the application in condition for allowance. The Examiner is respectfully requested to pass the application to issuance.

The Examiner is respectfully invited to call the Applicants' representative should it be deemed beneficial to further advance prosecution of the application.

Respectfully submitted,



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